REMARKS/ARGUMENTS

Favorable reconsideration of this application, in light of the present amendments and following discussion, is respectfully requested.

Claims 1-8 are currently pending; Claims 1 and 4 are currently amended; and Claims 5-8 are newly added. Support for the amendment to Claim 1 can be found at page 8, lines 13-16, the amendment to Claim 4 is to address a minor informality, and support for newly added Claims 5-8 can be found at page 6, line 11-page 8, line 11, for example. No new matter is added.

Claim 4 was objected to under 37 C.F.R. § 1.75(c) as a multiple dependent claim dependent on another multiple dependent claim; Claims 1-3 were rejected under 35 U.S.C. § 103(a) as obvious over Timsit et al. (U.S. Patent No. 5,232,788, hereafter "Timsit") in view of Evans et al. (U.S. Patent No. 5,771,962, hereafter "Evans"); Claim 4 was rejected under 35 U.S.C. §103(a) as obvious over Timsit in view of Evans further in view of Key to Metals webpage and Shepelev et al. (U.S. Patent No. 6,132,532, hereafter "Shepelev").

Regarding the objection to Claim 4 under 37 C.F.R. § 1.75(c) as a multiple dependent claim dependent from another multiple dependent claim, Claim 4 has been amended to depend from only non-multiple dependent claims. Therefore, Applicants respectfully request that the objection be withdrawn.

Regarding the rejection of Claims 1-3 as obvious over Timsit in view of Evans, Applicants respectfully submit that neither Timsit nor Evans, either alone or in combination, discloses every element of amended base Claim 1. For example, neither reference discloses the feature of, "A heat exchanger tube comprising an Al alloy extruded tube with an extrusion profile including a plurality of internal passageways, and a flux layer containing a Si powder and a Zn-containing flux formed on an external surface of the Al alloy extruded tube."

The present invention relates to a heat exchanger tube with high corrosion resistance. In conventional heat exchangers, thin walled metal tubes are connected to heat transfer fins and to larger tubes called "headers." The headers have thicker walls than the thin-walled tubes, therefore, corrosion of the heat exchanger tends to cause leaks in the thin-walled tubes earlier than in the headers.

In order to improve the corrosion resistance of the thin-walled tubes in conventional heat exchangers, a sacrificial anode layer containing zinc as a major component is added to the surface of the tubes by spraying on a zinc coating. However, the spray coating is difficult to control, and coating non-uniformity and pockets of unprotected tubing often occur. Therefore, corrosion resistance of the thin-walled tubes is difficult to enhance with only a conventional spray-on coating.

In light of these difficulties, the Applicants developed the present invention, as recited, for example, in Claim 1. Claim 1 recites:

> A heat exchanger tube comprising an Al alloy extruded tube with an extrusion profile including a plurality of internal passageways, and a flux layer containing a Si powder and a Zn-containing flux formed on an external surface of the Al alloy extruded tube, wherein an amount of the Si powder applied to the Al alloy extruded tube is not less than 1 g/m and not more than 5 g/m^2, and an amount of the Zn-containing flux applied to the Al alloy extruded tube is not less than 5 g/m^2 and not more than 20 g/m^2.

The addition of silicon powder provides better uniformity of coverage of the heat exchanger tube than could be achieved with conventional immersion or roll coating methods. The silicon powder turns into a brazing liquid during the brazing process, and zinc contained in the flux diffuses uniformly in the brazing liquid over the tube surface. The end result is a heat exchanger tube better protected from corrosion than heat exchangers coated by conventional methods because the zinc coverage of the thin-walled tube is more complete.

Timsit describes an aluminum alloy composite sheet for use in brazing. Brazing is often used for joining aluminum components together without welding. During brazing, an

aluminum brazing alloy is placed at the junction of the components to be joined. The brazing alloy must have a melting point lower than the melting point of the components to be joined. The brazing alloy is heated, melts, and then flows into joints between the two components via capillary action. The brazing process sometimes uses a "brazing sheet," a piece of high melting point material with one or more surfaces alloyed to have a lower melting point.[1] Such brazing sheets are commonly prepared by cladding a core aluminum alloy sheet on one or both faces with a brazing alloy. Typical brazing alloys for aluminum contain 7.5% to 15% silicon. Thus, a sheet of material would have at least two separate layers, at least one external layer of a low melting point cladding, and another layer of core aluminum beneath the cladding. The sheet is formed into useful components and then brazed to connect to other components to form a final assembly. The external cladded layer melts during the brazing process and attaches to a separate component placed in contact with the cladded layer. During the brazing process, the un-alloyed internal layer remains in a solid state. In this manner, a sheet metal component may be attached to a separate component without welding. However, conventional cladding required for brazing is expensive, and scrap recovery procedures for this material are difficult.[2]

Timsit eliminates the need for cladding with such high silicon content alloy by spraying an aluminum sheet with a mixture of a brazing flux material and of metal particles, thus solving the problem of expensive cladding and difficult recovery procedures. The aluminum sheet forms an alloy with the sprayed-on material to a depth of up to 10% of the sheet thickness.[3]

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[1] Brazing sheet is clad material comprised of two alloys that is used to create a bond in heat exchangers for automotive applications. A clad product is a multilayer metal/metal composite, in this case rolled into sheet. Brazing sheet consists of a high temperature melting point core alloy, sandwich between one or more low temperature melting point clads. http://www.alcoa.com/com_transport/en/products/category.asp ?country_id=999&market_id=30&market_cat_id=497&cat_id=238 (last visited 1-17-2005).

[2] Timsit, Column 1, lines 22-37.

[3] Timsit, Column 4, lines 27-31.

Evans describes joining components of a heat exchanger together with a controlled atmosphere brazing process. Magnesium is alloyed with aluminum in order to improve corrosion resistance. Conventional brazing processes had difficulties joining components made with high magnesium content. The magnesium would melt and form magnesium oxides which interfere with the wetability of the joint between the two components intended to be brazed together.[4] Evans solves this problem by including lithium or cesium in the brazing flux. Evans explains that the presence of lithium and/or cesium wets the joining surfaces better and forms larger fillets at the point of brazing because the formation of magnesium oxide is prevented and existing aluminum oxide on the surface of the components is disrupted.[5]

Applicants respectfully submit that the cited references, either alone or in combination, do not disclose every element of amended base Claim 1. Timsit and Evans do not disclose an, "Al alloy extruded tube with an extrusion profile including a plurality of internal passageways," for example. The brazing sheet described in Timsit is used in the fabrication of other products when a brazing process is involved. The sheet described in Timsit is very thin, on the order of 0.1 mm to 1 mm.[6] Nowhere in Timsit is the sheet described as extruded or as having an extrusion profile with a plurality of passageways. In fact, if the thin sheet described in Timsit did have an extrusion profile with a plurality of passageways, the passageways would be so small that any heat exchanger formed from this extrusion would not function for its intended purpose. Fluid flow through such small passageways would be extremely small and would not allow the heat exchanger to efficiently dissipate heat.

[4] Evans, Column 1, lines 43-67.
[5] Evans, Column 4, lines 61-67.
[6] Timsit, Column 4, lines 55-60.

Nor does Evans disclose any of these features. While Evans describes a tube with an internal and an external surface, the tube is not described as an extrusion with an extruded profile including a plurality of passageways. In fact, Evans states that one embodiment of the heat exchanger uses a turbulator (20) in order to create a more turbulent flow inside the tube and achieve greater heat transfer.[7] As the turbulator (20) is described as extending "longitudinally and laterally in a series of undulations" it is impossible for the tube in Evans to be an extrusion and to also contain a series of undulations. As an extrusion is formed by forcing a material through a die, an extrusion cannot have an external wall (tube wall) and also have a series of undulations inside. Therefore, the turbulator (20) must be a separate component that is inserted after the tube is already formed. Nor does the embodiment described without the turbulator (20) disclose an extrusion profile with a plurality of passageways. Therefore, both Timsit and Evans fail to disclose every element recited in amended base Claim 1.

Therefore, Applicants respectfully submit that amended base Claim 1 and Claims 2 and 3 which depend from Claim 1 either directly or indirectly patentably distinguish over the cited references for at least the reasons discussed above.

The outstanding office action relies on the Key to Metals webpage and Shepelev to provide the feature recited in dependent Claim 4. As neither the Key to Metals webpage nor Shepelev remedy the deficiencies in Timsit and Evans described above, Applicants respectfully submit that Claim 4 patentably distinguishes over cited references for at least the same reasons as discussed regarding amended Claim 1 from which Claim 4 depends either directly or indirectly.

As newly added Claim 5 also recites an "Al alloy extruded tube with an extrusion profile including a plurality of internal passageways," Applicants respectfully submit that

[7] Evans, Column 4, lines 14-20.

newly added Claim 5 and Claims 6-8 depending from Claim 5 either directly or indirectly patentably distinguish over the cited references for at least the reasons discussed above.

Consequently, in view of the above discussion, it is respectfully submitted that the present application is in condition for formal allowance and an early and favorable reconsideration of this application is therefore requested.

Respectfully submitted,

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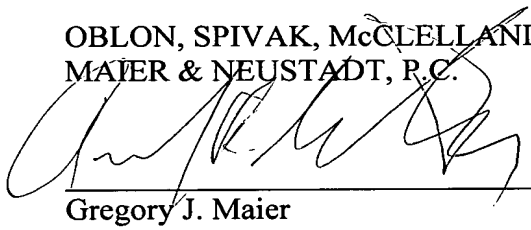

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